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ABSTRACT

A study identified the reading and mathematics job requirements for three sales and service jobs. Subjects were 296 employees of a marketing division of a large telecommunication company. The readability of 420 passages from job and training materials was assessed by the Flesch Reading Ease index, which generated a value that was transformed to a grade equivalent score. The 153 arithmetic problems obtained from the materials were assigned a grade equivalent score. The literacy test was the Test of Adult Basic Education. Job performance measures were obtained for 96 subjects to evaluate the validity of the literacy test for the prediction of worker performance. Results indicated the reading scores for 90 percent of the workers were at or above the 11th-grade level; 56 percent of the reading documents evaluated were at or above that level. Mathematics scores for 65 percent were at or above the ninth-grade level; 33 percent of the problems were at that level. The literacy test and a cognitive ability test predicted job performance with equal accuracy. Problems encountered in literacy research were identified, including dimensions of literacy as they relate to the workplace; measuring literacy skills of the workplace; and the level of mastery required to achieve proficiency on the job. (21 references; 10 tables) (YLB)

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LITERACY REQUIREMENTS FOR CUSTOMER SERVICE JOBS

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ABSTRACT

Literacy skill requirements for a set of customer sales and service jobs were determined by examining the reading and math grade levels of a sample of work documents. A literacy test was administered to 296 sales and service workers. Comparisions between job literacy requirements and worker literacy levels were made. In addition job performance data were obtained to evaluate the validity of the literacy test for the prediction of worker performance. The results indicated that the reading scores for ninety percent of the workers was at or above the eleventh grade level. Fifty-six percent of the reading documents evaluated were at or above the eleventh grade level. Similarly, the math scores for 65% of the incumbents in the study were at or above the ninth grade level and 33% of the math were at that level. The reading scores for job documents were higher (more difficult) than training documents. The literacy test and a cognitive ability test predicted job performance with equal accuracy. Problems encountered when conducting literacy research are discussed.

Literacy Requirements for Customer Service Jobs

In recent times there have been numerous reports alerting business and organizational leaders to work force changes and their implications. There are several important trends. First, the U.S. Department of Education estimates that 20% of the work force (27 million people) is functionally illiterate, that is, they cannot effectively use printed and written material to function in society. Findings from the National Assessment of Educational Progress (NAEP) study corroborate this finding and indicate that 27 million Americans (1) cannot read a newspaper or magazine and explain the main idea, (2) cannot derive and use information from tables, charts, or forms, and (3) cannot calculate the correct percentage for a tip or balance a checkbook. In addition, the U.S. Department of Education estimates that another 47 million adults are borderline illiterates - they cannot function proficiently in society.

A second worrisome trend is described by the Hudson Institute's Workforce 2000 report (Johnson, 1987). The report states that by the end of this decade there will be fewer workers available to fill jobs. The work force will grow by only 1.2% per year between now and the year 2000. This is the slowest growth rate since the 1930's. Work force growth averaged 2.2% per year between 1972 and 1986.

And finally, the news gets worse, the literacy problem is growing. While the literacy level of the work force is declining, the literacy requirements of jobs are increasing. At the present level of GNP growth, the economy will produce 1.5 million jobs per year during the 1990's. The Hudson Institute report estimated that half of these jobs will require at least 14 years of education compared to 13 years in 1986 and 12.5 in 1975.

The increase in the literacy requirements of jobs is due, in part,to growth in job families which require high levels of literacy. While overall job growth is expected to be about 19%, the greatest growth will occur for jobs such as scientist, engineer, and sales worker. The number of manufacturing jobs such as assembler and machine operator, which require lower levels of literacy, will actually decline in the 1990's.

Definitions of Literacy

Popular use of the term literacy refers to the three R's - reading, writing, and arithmetic. However, researchers have defined literacy differently. Their attention has been

focused on basic and functional reading literacy and arithmetic literacy.

Basic literacy refers to skills which are at grade levels three or four. A person whose reading competency, for example, is at the basic level has a sight vocabulary of about 2,500 words and reads at a rate of 95-120 words per minute.

Functional literacy is usually associated with a fifth or sixth grade level of competency. This level of competency is generally believed to be necessary to function in society. A person whose reading competency, for example, is at the functional level possesses a reading vocabulary of 5,000 to 6,000 words. Their reading rate is about 190-215 words per minute. Performance at the functional level suggests that the reader has learned basic comprehension skills and can locate facts in simple paragraphs, stories, news articles and can read simple assembly and safety instructions.

Kirsch and Jungeblut (1986) have distinguished among prose, document, and quantitative literacy. Document literacy refers to the skills needed to locate and use information contained in non-prose formats such as forms, tables, charts, signs/labels, indexes, schematics, and catalogues. Prose literacy refers to the skills needed to understand and use information from texts such as editorials, news stories, and poems. Quantitative literacy refers to the skills needed to perform arithmetic operations that are embedded in printed materials such as check book registers, order forms, and loan advertisements. These researchers have developed tests for each of these types of literacy and their work has formed the basis of the National Assessment of Educational Progress (NAEP) study which is the source of much of the literacy findings published in the popular press.

Some researchers have distinguished between reading-to-learn and reading-to-do (Mikulecky, 1985; Sticht, 1974). Reading-to-learn is the kind of formal reading performed in school. It is focused on mastering content, gaining new concepts and knowledge. It is uninterrupted and self-contained. In contrast, reading-to-do focuses on reading as a means to accomplish a task. Reading-to-do is, for example, reading a section of a copy machine's operating manual to insert new paper or reading safety instructions before operating a machine. Reading-to-do involves brief encounters with reading material and may be supplemented by diagrams, pictures, charts, tables, or additional written material. It may even include the opportunity to question a more knowledgeable co-worker.

Measuring Literacy Job Requirements

Job analysis information is critical to the development of numerous kinds of personnel programs, such as selection programs, training interventions, job evaluation, and work design. Traditional job analysis methods yield lists of tasks, knowledges, skills, and abilities required to successfully perform jobs. Rarely, however, do job analysts obtain information about literacy requirements.

Proven methods to measure literacy requirements of jobs do not exist. However, methods to measure prose literacy have been available for many years in the field of education. Book publishers use readability indexes to determine the difficulty level of their texts. School administrators use readability indexes to choose texts with appropriate difficulty levels. There are nearly 100 methods of measuring the difficulty of reading material (Tekfi, 1987). Readability indexes have their roots in research conducted in the 1920's. The indexes these researchers developed were atheoretical. They do not measure the syntactic or semantic features of text. These readability methods continue to be used today.

Many different variables were used before researchers determined that average sentence length and word difficulty were the best predictors of readability (Zakaluk & Samuels, 1989). Other variables which have been used successfully in readability indexes are number of polysyllabic words, number of different words, number of simple sentences, number of prepositional phrases, number of syllables per word, and number of low frequency words. Correlations among the different readability indexes are moderate to high, ranging from .63 - .94 (Carver, 1985; Olson, 1984; Sticht, 1974; Zakaluk & Samuels, 1988).

Readability validity coefficients have ranged from .35 - .52 (Tekfi, 1987) for single variable indexes and .65 to .87 for multiple variable indexes (Carver, 1985; Zakaluk & Samuels, 1988). Readability indexes are validated by correlating the readability index with scores from standard paragraphs of known reading difficulty. The reading difficulty scores of the standard paragraphs are determined by administering a reading comprehension test to a sample of people. The average reading comprehension score for each paragraph is the difficulty score for the standard paragraph.

A different approach to develop standard paragraphs is the cloze procedure (Taylor, 1953). The cloze procedure has frequently been used to construct reading comprehension tests for readability validation studies. Using job-related reading documents, the cloze procedure can easily produce a job-related reading comprehension test. A cloze test is constructed by taking a passage of at least 250 words and

deleting every fifth word. The missing words are replaced by a blank of standard length. Subjects then fill in the blanks with the word which best completes the sentence. The cloze score is obtained by counting the number of answers which are exactly correct. A passage's readability score is the average cloze score from an appropriate sample of test-takers.

Literacy and Job Performance

Although much attention has been given to the growing literacy gap, little research has been done to demonstrate the relation between literacy and job performance. Sticht et. al., (1974) conducted an extensive study of literacy for four low-level military jobs. His results indicated that, reading scores correlated between .32 and .40 with a job performance measure and arithmetic scores correlated between .26 and .36 with the same measure. In another military study Sticht, Hooke, & Caylor (1982) attempted to predict attrition and highest pay grade attained by recruits. Reading comprehension validity coefficients were .17 for attrition and .13 highest grade attained. For overall literacy, validities were .16 for attrition and .15 for highest pay grade attained. Interestingly, these researchers included a test of listening comprehension in the overall literacy battery. Listening comprehension validity results tracked closely with reading comprehension. The correlation between reading and listening comprehension was .73.

Based upon research (Sticht, et. al., 1982; Mikulecky & Ehlinger, 1985) which indicated the importance of job-related test content, Anderson and Stewart (1989) developed a job-specific reading test. The test content was based upon job materials obtained from the target jobs. The researchers hypothesized that a reading test based upon job-specific content would yield a higher validity coefficient than a general reading test. The job-specific reading test correlated .21 with one criterion and zero with the other. The general reading test did not correlate with either of the criterion measures.

Mikulecky & Ehlinger (1985) compared the validities from different reading comprehension tests for predicting job performance of electronics technicians. A general and a job-related reading comprehension test based upon the cloze procedure did not predict job performance. However, a reading comprehension test which measured the metacognitive skills associated with reading comprehension correlated .50 with job performance.

This study reports the initial findings of a research effort to link testing and training. The goals of this research are to (1) measure workers and jobs on the same scale and (2) identify scales which are job-related and for which a valid training program exists (or can be developed) to enhance the skills of those who are deficient. A testing program which establishes job skill standards and worker skills on the same scale and a training program which enables workers to attain the skill levels required by jobs may prove to be a critical organizational strategy to meet the challenges of the new demographics.

Literacy tests may be good candidates to accomplish these goals. There are two reasons. First, recent research suggests that effective literacy training may soon be more widely available. Cognitive psychologists have identified trainable metacognitive skills which are required for reading comprehension (Baker, 1988) and math (Glaser, 1989). Second, empirical support exists for the job-relatedness of literacy tests if one considers the high correlation between literacy and cognitive ability tests and the overwhelming amount of evidence for the job-relatedness of cognitive ability tests.

However, the difficulty with this strategy is the identification of a scale which measures job requirements and workers on the same scale. Literacy scales which measure workers and are equated to job requirement scales are not generally available. The need for such a scale is critical because a score of 52, for example, on a worker literacy scale must refer to the same amount of literacy as a score of 52 on the job requirement literacy scale.

If literacy tests were able to meet the goals of this study, information about literacy job requirements would aid in the determination of hiring standards. Information about the literacy levels of workers would aid in the selection of workers. Comparisons between literacy job requirements and the skill level of the work force would inform decisions about the amount and type of training needed by the work force. Course developers armed with knowledge of the literacy requirements of jobs and skill levels of the target population could ensure that the literacy requirements of the training are at an appropriate level. In addition, information about the variability in the types and levels of literacy requirements for different job groupings would be informative to those responsible for selection and training programs.

The purpose of this study was (1) to identify the reading and math job requirements and worker skill levels for three sales and service jobs, (2) compare literacy job requirements and the reading and math skill levels of the sales and service workers, (3) compare the reading and math

requirements of training and job materials, and (4) examine the validity of a literacy test.

In this study the scale used to measure job requirements and worker literacy was a grade equivalent scale. This scale is not free of the difficulties described above. However, there were no alternatives available and the grade equivalent scale was used, its limitations notwithstanding.

METHOD

Subjects - The subjects were 296 job incumbents employed by a marketing division of a large telecommunication company. This division has 10,000 employees of whom approximately 6,000 perform sales and service work. The incumbents hold non-exempt positions which involve both sales and service work. The positions differ with regard to the emphasis placed upon sales. One position strongly emphasizes sales. The sales workers in this position perform face-to-face retail sales, a portion of their earnings is based upon commission. A second position balances sales and service equally, and a third position emphasizes service. The service and the sales & service workers perform their duties over the telephone. There is no commission involved in their work.

The sample was drawn from three different regions of the United States. Incumbents had been preselected on a cognitive ability test. Females comprised sixty-six percent of the sample.

Documents - The documents were drawn from job and training materials. Job materials included job aids, methods and procedures manuals, interoffice memos, customer letters, and printed copies of text which are read from a computer screen. The job documents evaluated for reading difficulty were a random sample of 30 - 50 documents per job and the training materials were randomly chosen passages from the initial training program for each job type. All training and job documents which were obtained for this study were searched for occurrences of arithmetic problems. The search yielded 153 samples of arithmetic problems. These were used in the subsequent analyses.

Readability - There were 420 passages whose readability was assessed by the Flesch Reading Ease (FRE) index. The FRE index generated a value which was then transformed to a grade equivalent score. The transformation was necessary to enable the comparison of document scores and subjects' literacy scores. The FRE index is based upon the average sentence length and the average number of syllables per word in a 100 word passage.

In order to ensure the accuracy of the FRE, a sample of 162 passages was analyzed again using the Degrees of Reading Power (DRP) index. According to the DRP Handbook (1986), the DRP index has higher validity and a smaller standard error than any other index. The DRP index was validated against reading comprehension tests based upon the cloze procedure. However, the DRP index does not produce a score on a grade equivalent scale. Therefore, comparisons with subjects' literacy scores are difficult. The correlation between the DRP and the FRE indexes served as a check on the accuracy of the FRE. The correlation was .58.

Arithmetic Scale - The 153 arithmetic problems obtained from the job and training materials were assigned a grade equivalent score by a rater on the basis of three factors. The three factors were (1) the operations involved (addition, subtraction, multiplication, division, etc.), (2) the number of steps required to reach a solution, and (3) the complexity of the arithmetic problem. The number of steps was determined by counting the number of operations required to reach a solution. For example, a problem which requires addition, multiplication, and then addition is a three step problem. Complexity refers to the number of different operations required to solve a problem. The previous example is moderately complex because two different kinds of operations were required to solve the problem.

The rater used these criteria to classify the 153 arithmetic problems. Using these criteria, a second rater re-rated a sample of 50 arithmetic problems. The raters assigned the same grade level for 75% of the problems.

Test of Adult Basic Education (TABE) - The literacy test used in this study was the TABE - Short Form (McGraw-Hill, 1986). The long form of the TABE requires four hours to complete and was judged to be administratively infeasible for the purposes of this study. The short form of the test requires 70 minutes to complete and is comprised of six subtests, each of which contains fifteen items. The subtests combine to form a reading, math, and language test. The reading test is comprised of vocabulary and reading comprehension subtests. The math test is comprised of math computation and math concepts and applications subtests. The language test is comprised of language expression and language mechanics subtests. Raw scores were used for the statistical analyses of the TABE test results.

Criterion Measures - Job performance measures were obtained for a sample of 96 subjects. Four measures were used. First, supervisors provided job observation ratings for four live customer interactions. Second, supervisors provided sales ratings of five steps in the sales process (sales initiation, fact finding, sales presentation, overcoming objections, and closing). Next, supervisors provided three

service ratings which assessed the efficiency, quality, and adherence to policy for their non-sales work. Each of the ratings was summed to form a summated job observation rating, summated sales rating, and summated service rating. The summated ratings were used in the subsequent analyses.

The fourth job performance measure was sales quota. For each subject, sales quota results were obtained for four consecutive months. The average of these four months served as the sales quota criterion.

RESULTS

Readability - A 2 X 3 ANOVA was performed on the FRE averages contained in Table 1a. The ANOVA results (Table 2a) indicated that there were significant differences between the different job types ($F=9.40$, $df=2$, $p<.001$) and between job and training documents ($F=22.82$, $df=1$, $p<.0001$). The sales & service documents were the most difficult while the service documents were least difficult. Job materials were more difficult than training documents. Overall, the average FRE grade equivalent was 11.7.

Math problems - A 2 X 2 ANOVA was performed on the math grade equivalents averages contained in Table 1b. The ANOVA results are contained in Table 2b. Two of the three job types (sales and sales & service) were included in this analysis. The sales & service (mean=8.1) math problems were significantly more difficult than the sales math problems (mean=7.7, $F=5.93$, $df=1,149$, $p<.02$). Unlike the reading documents, no significant difference was found between the job (mean=7.9) and training (mean=8.0) math problems.

Skill analysis - Table 3 contains the percentage of incumbents who attained different reading grade equivalent levels. Overall, 56% of the documents were at the 11th grade level or higher and 10.2% of the incumbents did not attain reading scores at the 11th grade level. None of the incumbents fell below the sixth grade level, into the illiteracy category nor were any documents written at this level.

Significant differences were found for the northeast region compared to the midwest or west. The mean for the northeast (mean=23.5) was significantly lower than the midwest (mean=24.8, $t=1.96$, $p<.05$) or west (mean=24.9, $t=2.59$, $p<.01$).

Table 4 contains the results of analyses of the percentages of incumbents who attained different math grade equivalent levels. Overall, 33% of the documents were at the 9th grade level or higher and 29.5% of the incumbents did not attain math scores at the 9th grade level. Five percent of the

incumbents fell below the sixth grade level, into the illiteracy category. Only 1.5% of the math problems were at that level.

Significant differences were found for the northeast region compared to the west. The mean for the northeast (mean=16.2) was significantly lower than the mean for the west (mean=19.0, t=3.11, p<.002). Females performed less well (mean=17.4) than males (mean=20.0, t=3.51, p<.0005) and the average score for blacks (mean=15.8) was lower than the average score for whites (mean=19.7, t=3.77, p<.0002).

Table 5 contains the results of analyses of the percentages of incumbents who attained different language grade equivalent levels. There was no measure of the language requirements of job and training documents. However, if the standard were set at the 11th grade level, 31.3% of the incumbents did not attain language scores at the 11th grade level. This indicates that 31.3% of the incumbents cannot adequately meet the language requirements of 50% of the task which might require these skills.

Achievement rates differed among subgroups. Significant differences were found between the northeast region (mean=20.2) and west (mean=22.2, t=3.25, p<.001) and between the northeast and midwest (mean=22.3, t=2.67, p<.008). Significant differences were also found between blacks (mean=20.8) and whites (mean=22.4, t=2.21, p<.03).

Validity coefficients - Predictor and criterion data were available from a subset of the service and sales & service incumbents only. Table 6 contains the validity coefficients for this sample. Overall, 13 of the 44 validity coefficients (30%) were statistically significant (p<.05). The validity coefficients for the cognitive ability and literacy tests for sales quota were .29 (p<.05) and .28 (p<.05), respectively.

The highest validity coefficients were obtained with the sales quota criterion. Except for reading and the comprehension subtest, significant correlations were observed for all literacy tests and subtests and sales quota. Significant correlations were also observed for the sales rating criterion, the language test, and the language expression and vocabulary subtests. In addition, the vocabulary subtest correlated significantly with the job observation rating. No test or subtest correlated with the service rating.

Table 7 contains the validity coefficients for the service job (n=61) and the sales & service job (n=34). For the sales & service job, four of the 16 validities (25%) were significant while none of 16 was significant (p<.05) for the service jobs. This was despite the fact that the sample

size was almost twice as large for the service jobs. If the probability of a Type I error is permitted to increase to 10%, ten of the 16 sales & service validity coefficients were significant and three of the service validity coefficients were significant. Also, twelve of the sixteen sales & service validity coefficients were larger than the corresponding service validity coefficients.

Literacy and cognitive ability - Table 8 contains the correlations among the cognitive ability test, the literacy test, and its subtests. The correlation between the cognitive ability and the literacy tests was .58 ($p<.01$). The correlations between the cognitive ability test and the literacy subtests ranged from .40 for language expression to .52 for math. The correlations between the literacy test and its subtests ranged from .68 for vocabulary to .87 for math. The lowest correlation between any pair of subtests was .31, between math computation and vocabulary. Moderate to high correlations were obtained for the reading subtests, vocabulary and comprehension ($r=.53$), math subtests, computation and concepts and applications ($r=.93$), and language subtests, expression and mechanics ($r=.58$).

DISCUSSION

The results of this study indicated that for a set of sales and service jobs, an eleventh grade level of reading and a ninth grade level of math skills were associated with mastery of 44% of the reading and 67% of the math tasks contained in the sample. Job documents associated with reading tasks were more difficult than training documents. This is the opposite of findings by Sticht et. al., (1974).

The results also indicated that none of the sales and service incumbents were below the sixth grade level of reading performance (the standard for functional literacy) and 90% were at or above the eleventh grade. This compares favorably to the putative literacy rates in the general work force wherein 20% are estimated to be illiterate and 40% inadequately proficient. This finding is most likely attributable to the fact that incumbents in these jobs were screened on a cognitive ability test which correlated .58 with the literacy test.

The findings were somewhat less encouraging with respect to math literacy. Five percent of the incumbents were below the sixth grade level (functional literacy) and an additional 30% percent were between the sixth and eighth grade levels.

The literacy and cognitive ability tests both predicted job performance with the same degree of accuracy. However, the cognitive ability test validity coefficient was limited by

the effects of explicit range restriction and incidental range restriction limited the literacy test validity coefficient. Validity coefficients for sales & service jobs were consistently higher than for service jobs. A possible explanation for this finding is that the criteria were more appropriate for the sales & service jobs than for the service jobs.

One surprising finding was that the language test was the best predictor of job performance. Generally, language mechanics and language expression are not included in a definition of literacy, but according to these findings, language skills may be an important literacy skill which accounts for differences in job performance.

Challenges encountered in literacy research

Literacy researchers are faced with many questions and challenges. There are a number of problems related to the establishment of job requirements and the measurement of work place literacy.

First, what are the dimensions of literacy as they relate to the work place? Investigators have focused on reading and math. Other dimensions such as writing, language skills, listening comprehension, and oral expression may prove relevant. This study identified language skills as a potentially relevant dimension. Sticht et. al., (1982) found that reading and listening comprehension correlated .72 with one another and they both predicted job performance.

Second, how does one measure the many aspects of literacy? Researchers who wish to measure the literacy job requirements for skills such as math and language must create their own scales. No standardized, validated methods currently exist.

Third, which of the many readability methods best measures job requirements? Does the distinction between document and prose literacy serve a purpose? Also, while correlations among readability measures are reported to be high, the actual grade equivalent levels assigned may differ. These differences may lead to underestimates or overestimates of literacy requirements. The importance of appropriate scales has already been mentioned.

Fourth, how does one measure the literacy skills of the work force? The NAEP studies led by Kirsch and Jungeblut (1986) have made significant contributions. The NAEP scales measure prose, document, and quantitative literacy. These scales have not been validated against job performance.

However, they have developed scales which measure people and tasks (similar to job tasks) on the same scale.

Fifth, are different literacy tests required for different job groups and levels of skill? Researchers investigating reading comprehension (Baker, 1988; Glaser, 1990) have observed that the cognitive strategies used by readers are related to the level of domain knowledge the reader possesses. The implication here is that the measurement instrument must reflect differences associated with job groups and the level of skill measured.

Sixth, what level of mastery is required to achieve proficiency on the job? Are workers who are able to master 75% of the documents fully proficient on the job? If not, what is the correct percentage? What is the relation between skill mastery and job proficiency? The relationship is most likely linear. However, to inform selection and training decisions, knowledge of literacy mastery levels associated with different levels of job proficiency would be valuable.

Recent findings in cognitive psychology provide direction for addressing some of these questions and challenges. Cognitive psychologist have made significant progress toward understanding the cognitive processes associated with tasks such as reading and math (Brown, 1984; Sheehan & Mislevy, 1989; Baker, 1988). Elucidation of the cognitive processes used to perform these and other literacy tasks provide insight to the relevant dimensions to be measured. This work has begun to influence psychometrics (Embretson, 1985).

Based upon the advances in cognitive psychology, Brunderson (1988) proposed a new measurement approach which "uses calibrated measures embedded in a curriculum to continuously and unobtrusively estimate dynamic changes in the learner's proficiency." This approach exploits findings in cognitive psychology. As the learner progresses, the assessment system generates intelligent prescriptions for appropriate instruction. In this model, relevant dimensions of cognitive processes form the basis for training and measurement models. Testing and training are linked.

Research on the effectiveness of literacy training has not been encouraging (Triandis, Feldman, Weldon, & Harvey, 1975). Previous approaches to training literacy were not based upon the advances in cognitive psychology which have occurred in the past ten years. Recent findings suggest the possibility of greater success with methods which teach metacognitive strategies (Glaser, 1989). In addition, most of the literacy training research has focused on those with very low literacy levels (Triandis, Feldman, Weldon, & Harvey, 1975). Many workers are well above the functional

literacy threshold, but are below a point of full proficiency required by their jobs. Literacy training for this population may be more successful.

These challenges represent the limitations of this study. Much work must be done to link testing and training. But, given the changing demographics and their impact on selection programs, training interventions, work and organizational design much is to be gained. Industrial psychologists are uniquely positioned to assist organizations meet these challenges. The current study was intended to be an initial step to address these challenges and gain an understanding of literacy in the work place.

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Table 1a - Mean, standard deviation, and sample size for the FRE index overall, for source (training vs. job documents) and each job type (sales, service, and sales & service).

	Mean	Standard Deviation	Sample Size
Job Documents	12.3	2.8	229
Sales	12.4	2.5	87
Service	11.8	3.1	100
Sales & Service	13.1	2.7	42
Training Documents	11.0	2.4	191
Sales	10.9	2.2	63
Service	10.7	2.4	99
Sales & Service	12.2	2.1	29
Overall	11.7	2.7	420

Table 1b - Mean, standard deviation, and sample size for the math index overall, for source (training vs. job documents) and each job type (sales and sales & service).

	Mean	Standard Deviation	Sample Size
Job Documents	7.9	0.92	65
Sales	7.9	0.92	37
Sales & Service	8.0	1.1	28
Training Documents	8.0	1.0	88
Sales	7.5	1.2	28
Sales & Service	8.2	0.8	60
Overall	8.0	1.0	153

Table 2a - ANOVA results for the FRE readability index for source (training vs. job documents) and each job type.

Source Table	SS	df	MS	F	p-value
Source (S)	153.44	1	153.44	22.82	.0001
Job Type (J)	126.38	2	63.19	9.40	.0001
S X J	4.19	2	2.10	.31	.7324
Error	2770.94	412	6.73		
Corrected Total	3054.96	417			

Table 2b - ANOVA results for the math problems obtained from the work documents for source (training vs. job documents) and job type (sales and sales & service).

Source Table	SS	df	MS	F	p-value
Source (S)	5.70	1	5.70	5.93	.02
Job Type (J)	0.03	1	0.03	.03	.86
S X J	2.61	1	2.61	2.72	.10
Error	143.24	149	.96		
Corrected Total	151.58	152			

Table 3 - Reading grade equivalent percentage distributions for the documents and workers for the different job types and demographic variables.

	Below 6th Grade	6th Grade to 10th Grade	11th Grade & Above	Total
Job Type				
Sales	0.0	6.6	93.4	45
Service	0.0	9.8	91.2	174
Sales & Svc	0.0	18.8	81.3	48
Sex				
Females	0.0	10.8	89.2	176
Males	0.0	8.9	91.1	79
Race				
White	0.0	6.1	93.9	115
Black	0.0	13.0	87.0	30
Region				
Northeast	0.0	18.7	81.3	48
Midwest	0.0	12.3	87.7	65
West	0.0	8.2	91.8	108
Total	0.0	10.2	89.8	265
Documents	0.0	44.1	55.9	420

Table 4 - Math grade equivalent percentage distributions for the documents and workers for the different job types and demographic variables.

	Below 6th Grade	6th Grade-8th Grade	9th Grade & Above	Total
Job Type				
Sales	2.2	26.6	71.2	45
Service	3.4	28.2	68.4	174
Sales & Svc	16.7	35.4	47.9	48
Sex				
Females	6.8	31.8	61.4	176
Males	1.3	20.3	78.4	79
Race				
White	2.6	20.8	76.6	115
Black	10.0	53.4	36.6	30
Region				
Northeast	16.7	35.4	47.9	48
Midwest	4.6	26.2	69.2	65
West	2.8	19.5	77.7	108
Total	4.9	29.5	65.6	265
Documents	1.5	65.5	33.0	153

Table 5 - Language grade equivalent percentage distributions of workers for the different job types and demographic variables.

	Below 6th Grade	6th Grade-10th Grade	11th Grade & Above	Total
Job Type				
Sales	2.2	8.8	89.0	45
Service	4.6	28.1	67.2	174
Sales & Svc	18.7	28.8	52.1	48
Sex				
Females	6.8	23.2	70.0	176
Males	6.5	26.5	67.1	79
Race				
White	4.4	22.6	73.0	115
Black	13.4	30.0	56.6	30
Region				
Northeast	18.7	28.8	52.1	48
Midwest	6.2	32.2	61.6	65
West	3.7	25.0	71.3	108
Total	6.1	25.2	68.7	265

Table 6 - Validities (uncorrected) of the cognitive ability test, the literacy test, and subtests for each of the criterion measures, sample sizes are in parentheses.

	Criterion Measures			
	Sales Quota	Job Observation	Service Rating	Sales Rating
Cognitive Ability Test	.29	.06	.11	.11
	(49)	(56)	(51)	(54)
Literacy Test	.28	.14	.11	.18
	(85)	(94)	(86)	(92)
Reading	.20	.21	.02	.17
	(85)	(94)	(86)	92
Vocabulary	.23	.27	.05	.23
Comprehension	.11	.08	-.02	.04
Math	.23	.06	.12	.09
	(84)	(93)	(85)	(91)
Computation	.20	.01	.12	.06
Concepts	.25	.12	.11	.14
Language	.30	.14	.11	.23
	(85)	(94)	(86)	(92)
Mechanics	.25	.08	.12	.17
Expression	.30	.19	.09	.25

Table 7 - Literacy test validity coefficients (uncorrected) for the service (n=61) and sales & service jobs (n=34).

	Sales Quota	Job Observation	Service Rating	Sales Rating
Composite				
Service	.17	.23	.22	.05
Sales & Svc	.47	.19	.28	.33
Reading				
Service	.16	.16	.20	.00
Sales & Svc	.33	.32	.31	.32
Math				
Service	.06	.21	.18	.03
Sales & Svc	.46	.06	.18	.22
Language				
Service	.24	.21	.17	.09
Sales & Svc	.43	.20	.30	.36

Table 8 - Correlations among the cognitive ability test, literacy test, and its subtests (n=203-294).

	2	3	4	5	6	7	8	9	10	11
1. Cognitive	.58	.45	.40	.40	.52	.48	.48	.46	.41	.40
2. Literacy	1.0	.78	.68	.70	.87	.77	.83	.84	.76	.74
3. Reading		1.0	.88	.87	.48	.38	.50	.62	.49	.62
4. Vocabulary			1.0	.53	.40	.31	.42	.54	.43	.55
5. Comprehension				1.0	.44	.36	.46	.54	.43	.53
6. Math					1.0	.93	.93	.55	.53	.45
7. Computation						1.0	.72	.48	.48	.37
8. Concepts							1.0	.55	.50	.47
9. Language								1.0	.91	.86
10. Mechanics									1.0	.58
11. Expression										1.0

Table 9 - Correlations among the criterion measures (n=96).

	Job Observation	Service Rating	Sales Rating
Quota	.22	.32	.36
Job Observation		.35	.68
Service Rating			.32

Table 10 - Means, maximums, standard deviations, and sample sizes for the cognitive ability test, the literacy test and its subtests, and the criterion measures.

	Mean	Maximum	Standard Deviation	Sample Size
Cognitive Ability Test	78.5	120	11.0	203
Literacy Test	64.4	90	2.0	294
<u>Raw Scores</u>				
Reading	24.5	30	3.5	294
Math	18.0	30	5.9	294
Language	21.9	30	4.2	294
<u>Grade Equivalent Scores</u>				
Reading-GE	12.3	12.9	1.6	294
Math-GE	9.9	12.9	3.0	294
Language-GE	11.5	12.9	2.4	294
<u>Criterion Measures</u>				
Sales Quota	148.4	----	45.1	86
Job Observation	11.5	20.0	3.3	96
Service Rating	9.5	15.0	2.3	96
Sales Rating	13.9	25.0	4.8	96